PACE Science Team:

Atmospheric Correction over Bright Water Targets with Non-negligible Radiances in the Near Infrared

Heidi Dierssen, UCONN

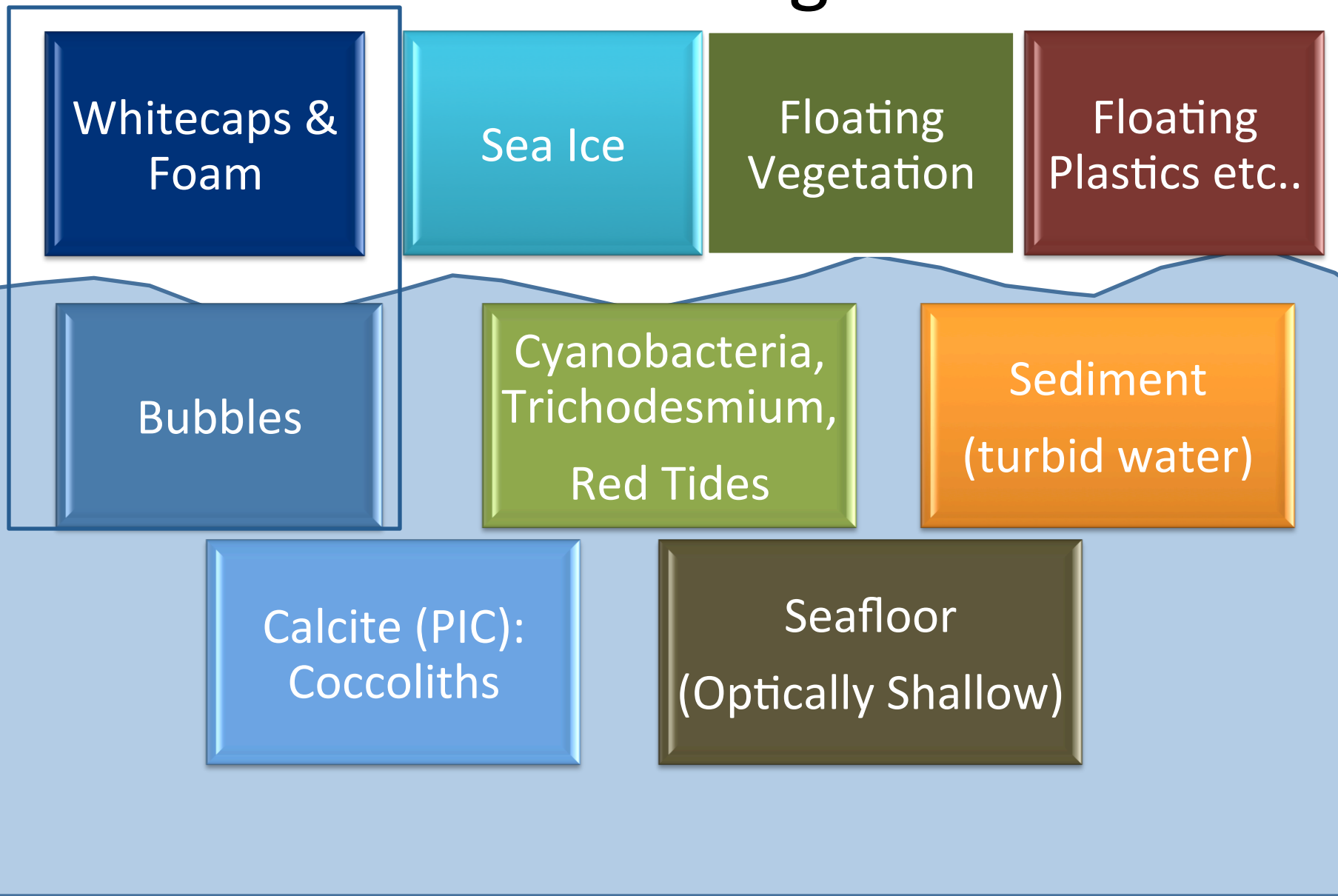
Kate Randolph, Ph.D. student/Postdoc

Brandon Russell, Ph.D. student

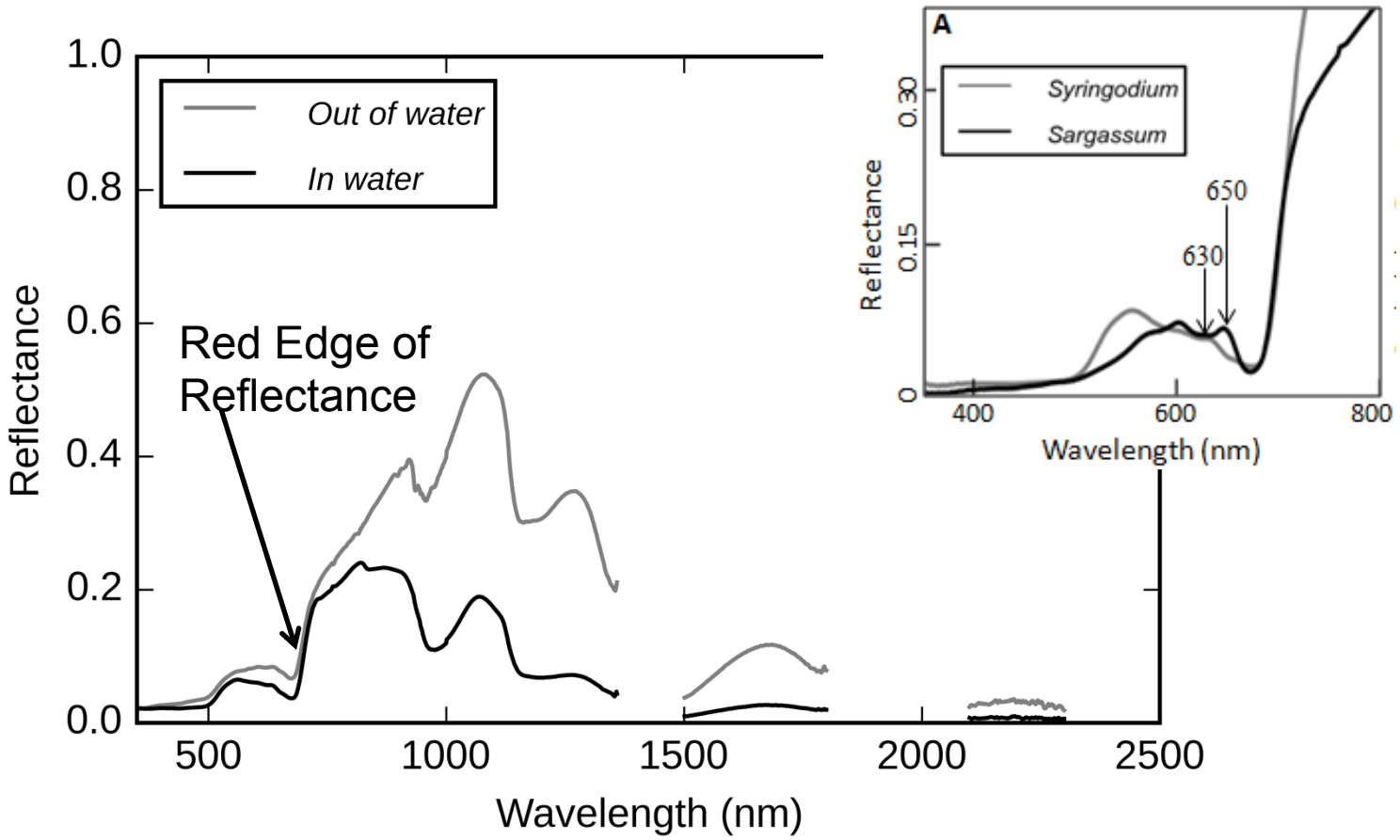
Shungu Garaba, Postdoc

Photo by Bill Lindsay

What causes "Bright Water"



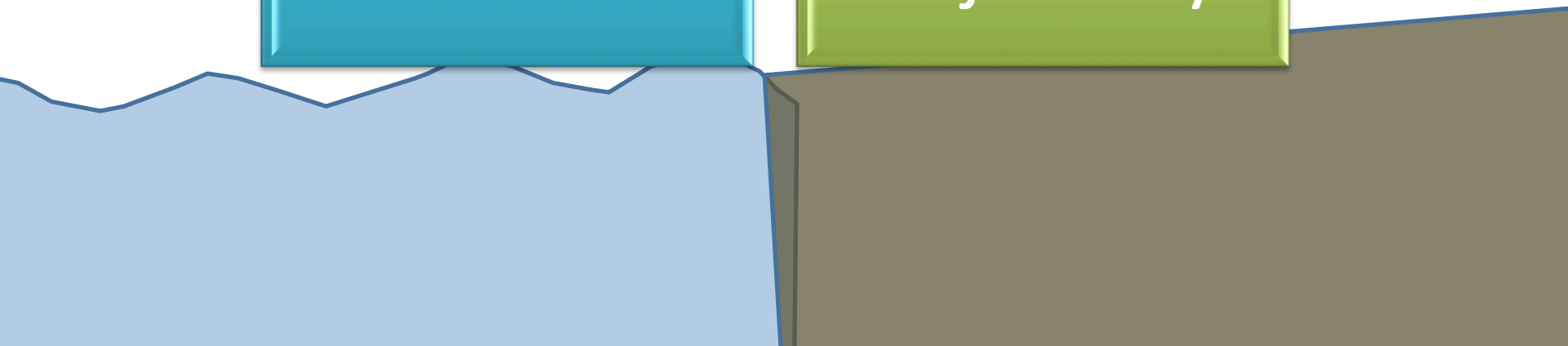
Floating Vegetation: Seagrass Wrack



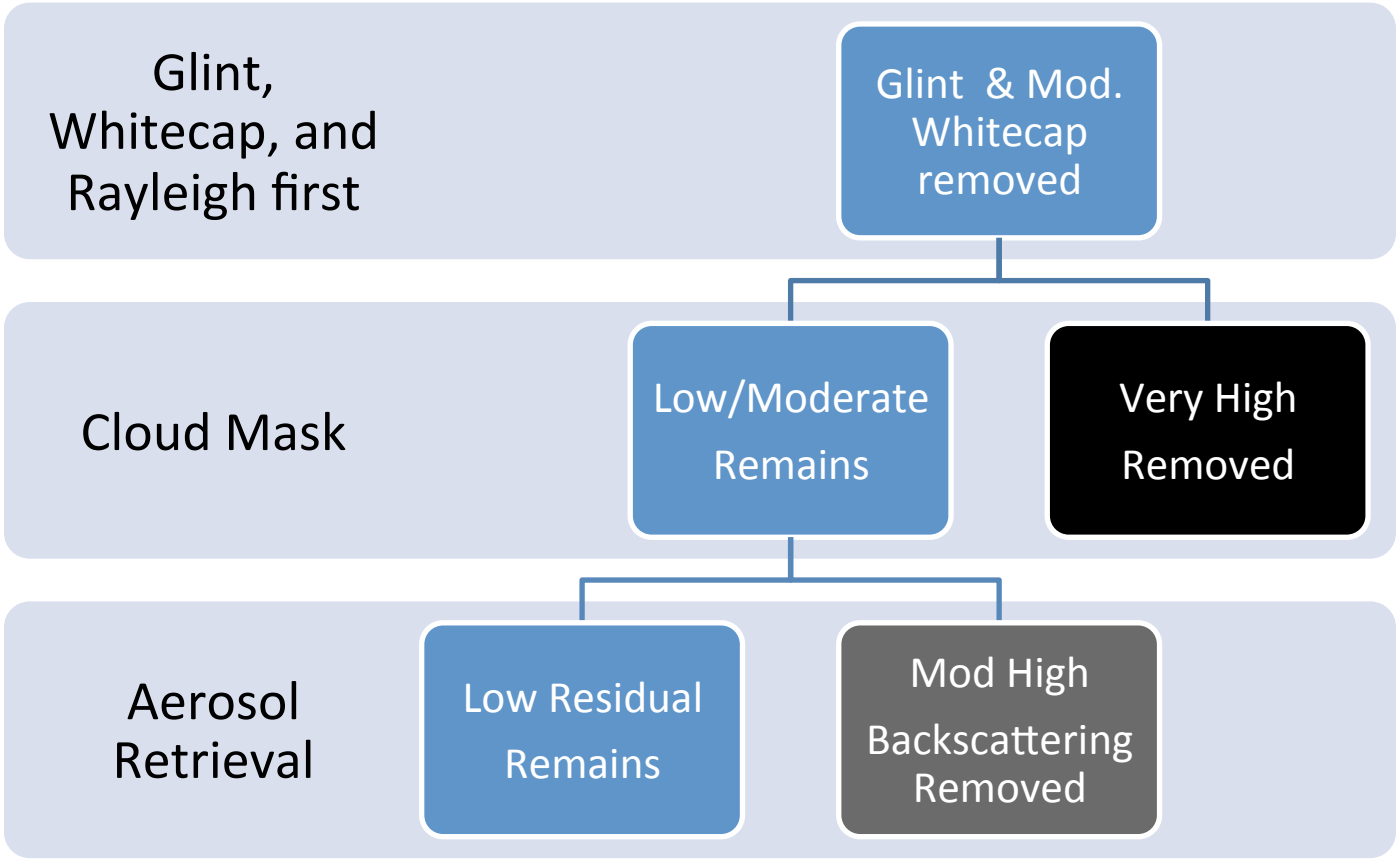
Dierssen et al. submitted RSE

What can appear like “Bright Water”, but isn’t water at all

- Thin Clouds
- Atmospheric dust
- Sun Glint
- Land/Ocean Adjacency



Current NASA AC processing removes highly reflective waters



Errors are not simple "quantitative" numbers.
Error of Omission excluding from one category
Error of Commission adding this stream to another category

Particulate Inorganic Carbon Alternate Approaches

2 - Algorithm Description

Inputs:

- Two-band approach
  - nLw(443)
  - nLw(550)
- Three-band approach
  - Spectral top-of-atmosphere reflectances
  - Reflectance due to Rayleigh scattering in the absence of aerosols
  - Diffuse transmittance of atmosphere from sun to sea surface and from sea surface to sensor
  - Three wavelengths from avelengths from ~670 to ~865 nm
- The 3-band method is implemented when the 2-band method fails.

Output:

- pic, the concentration of particulate inorganic carbon in mol m^{-3}

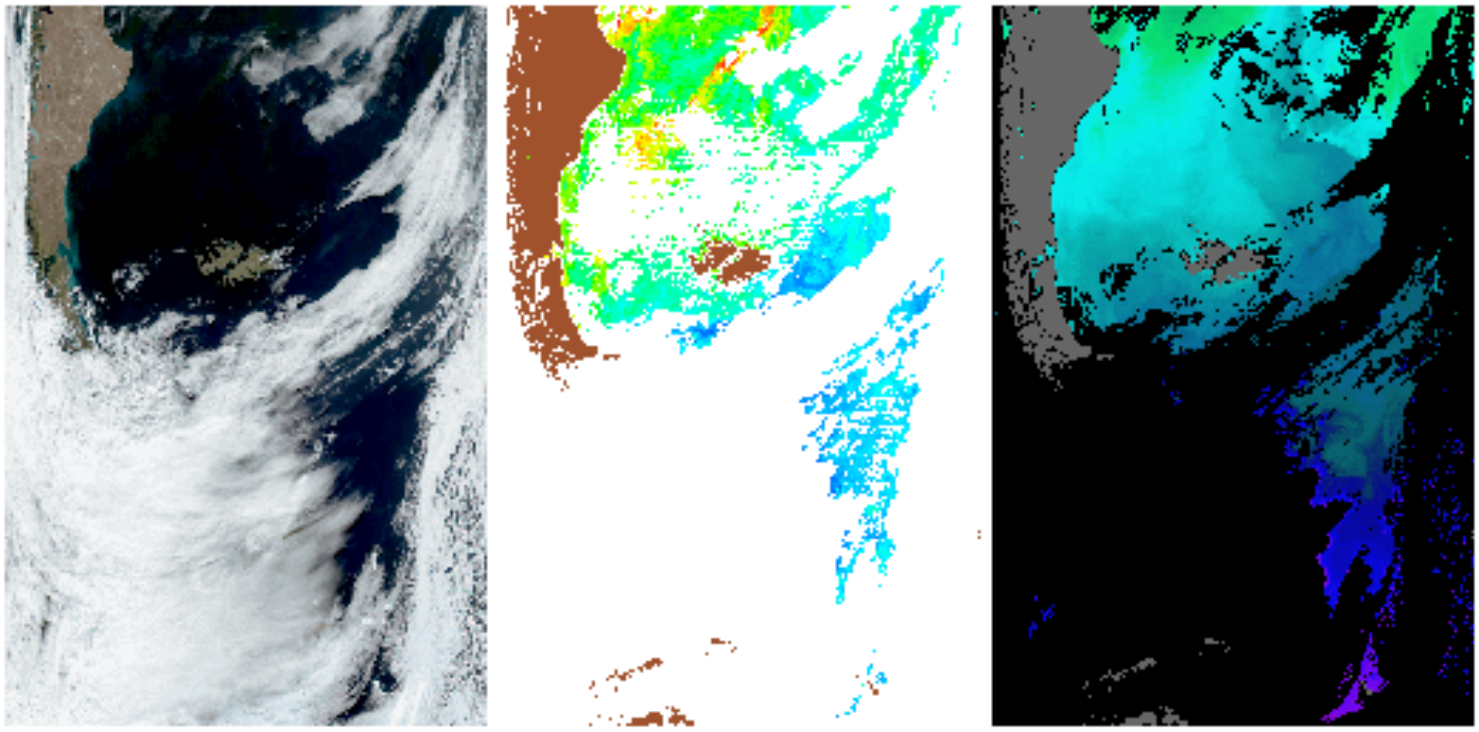
Example of “Bright Water” being masked

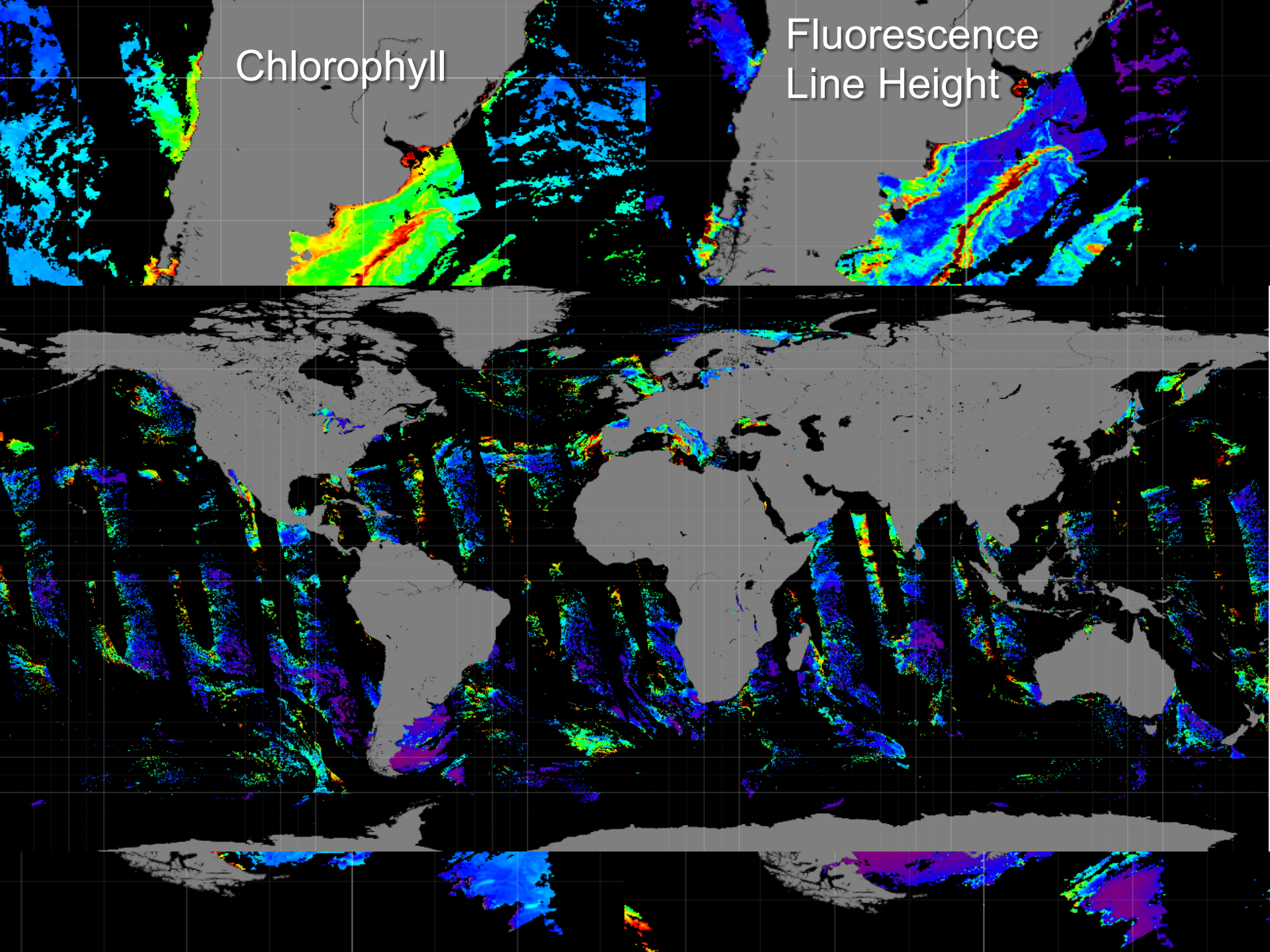
A2008089181000.L0_LAC	276,177,859 bytes
A2008089181000.L1A_LAC	55,473,494 bytes
A2008089181000.L2_LAC	16,938,918 bytes
A2008089181000.L2_LAC_SST	5,740,875 bytes

(The above hyperlinks point to bzip2-compressed HDF files.
Documentation on these products can be found HERE.)

Deselect this scene

Quasi True Color	Chlorophyll	Sea Surface Temperature (11 µ)

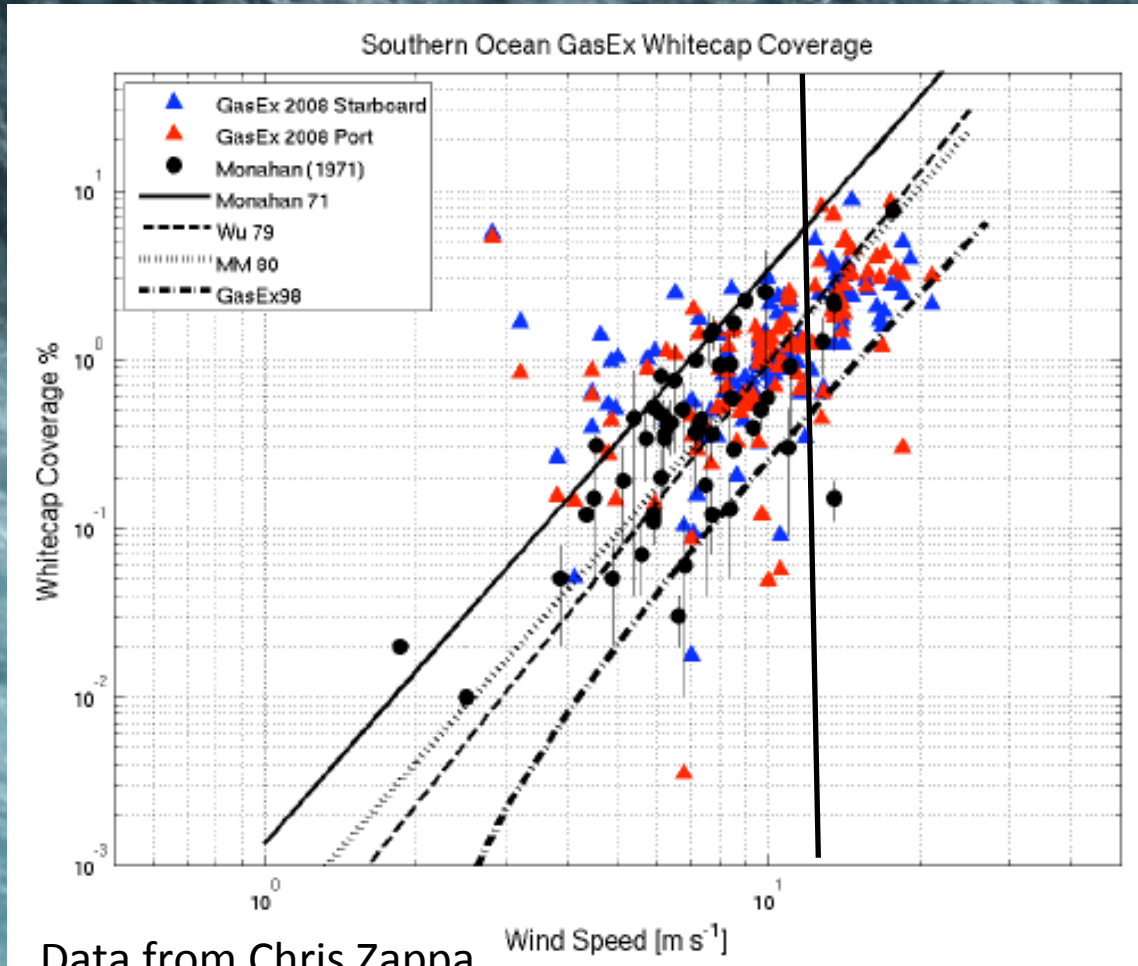



Chlorophyll
Fluorescence
Line Height

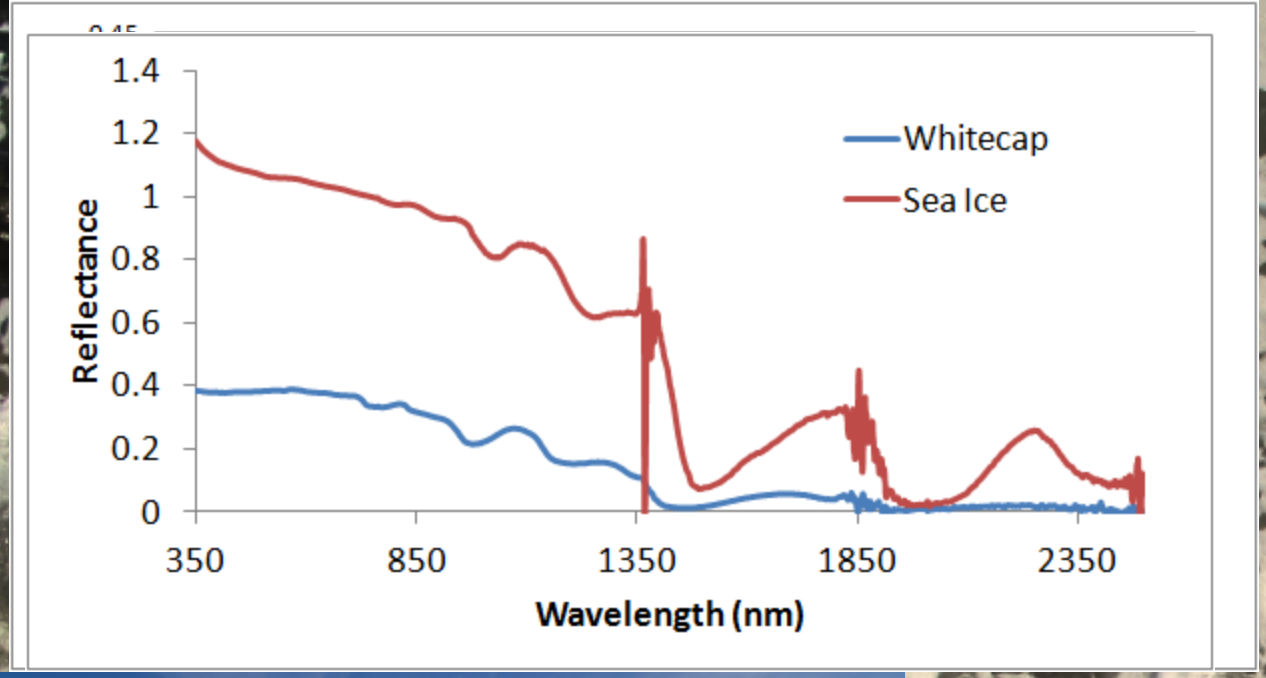
Windspeed is not an accurate predictor of Whitecap coverage

Photo by Scott Freeman

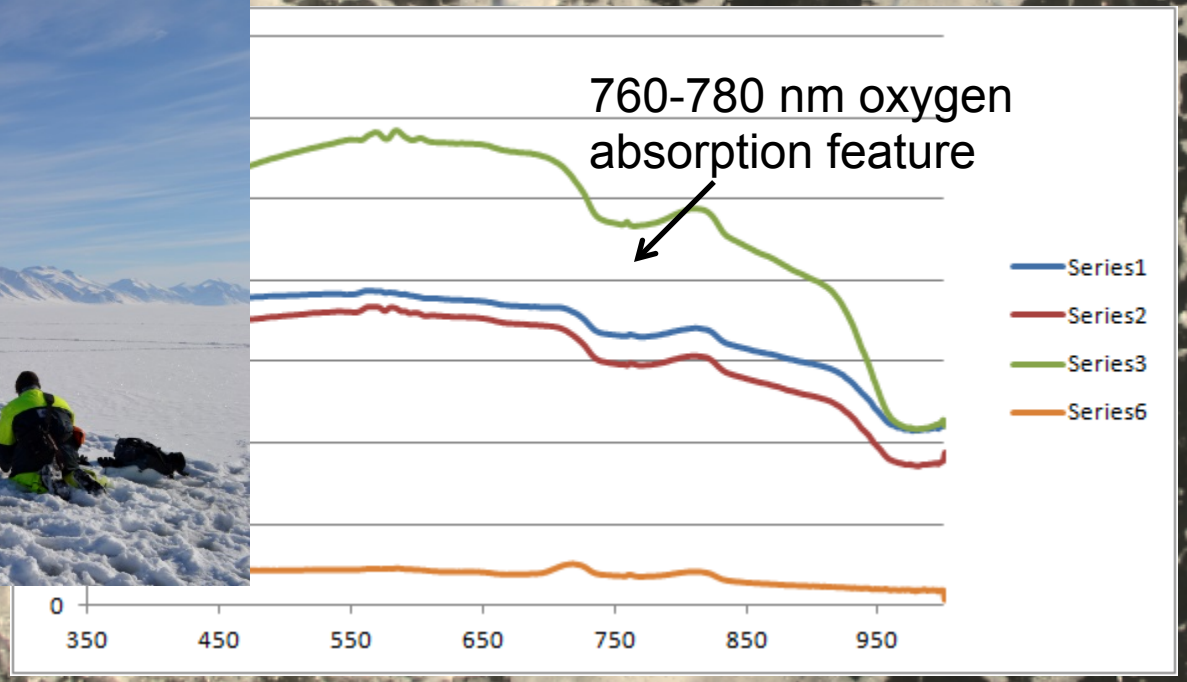
Field Experiments:
UCONN
Rrs (350-2500 nm) above water
In-water reflectance
LISST
Critical angle backscattering



Data from Chris Zappa


1.4
1.2
1
0.8
0.6
0.4
0.2
0
Reflectance
350
850
1350
1850
2350
Wavelength (nm)
Whitecap
Sea Ice

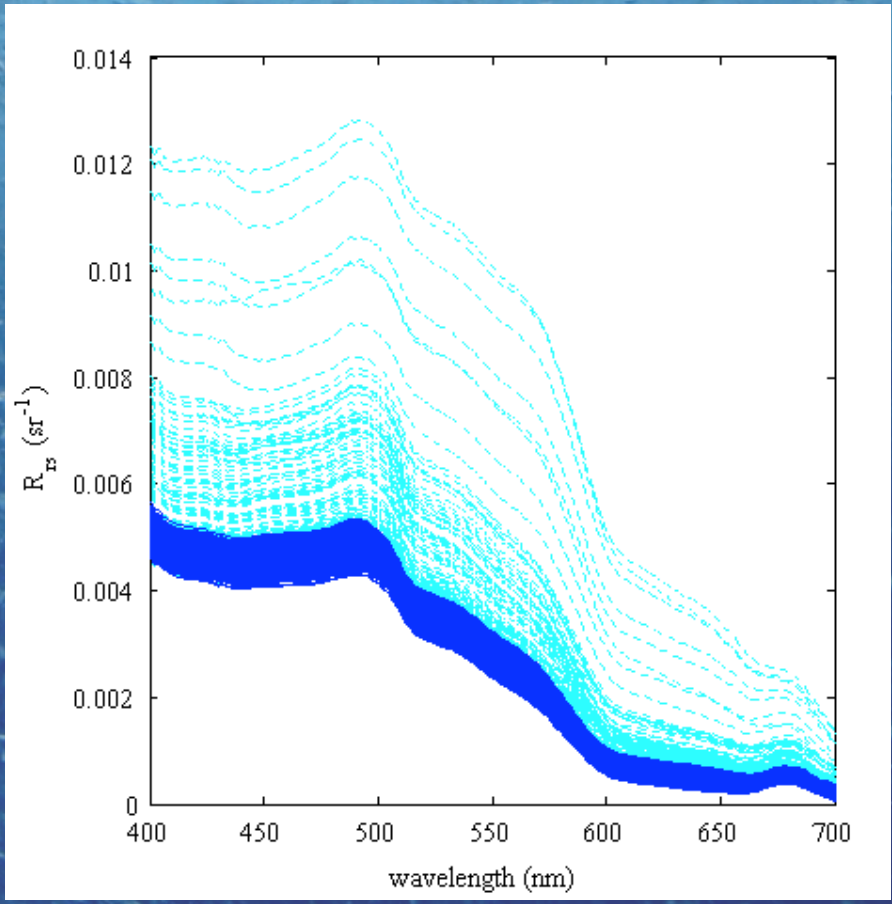

Wood Fjorden Svalbard


760-780 nm oxygen absorption feature
0
350
450
550
650
750
850
950
Series1
Series2
Series3
Series6

Bubbles separate from whitecaps

(1) Strongly enhance the upwelling irradiance field (Stramski and Tegowski, 2001)

(2) Bubble mediated gas transfer of low solubility gases (Broecker, 1983; Woolf & Thorpe, 1991)



Bubbles (Stage B whitecaps)

Implement more nuanced masks and screens

- Identify spectral features early:
  - Vegetation
    - Red Edge Reflectance (all concentrated vegetation)
    - Chlorophyll fluorescence peak
  - Sediments
  - Glint using water, oxygen or other absorption features
  - "White" objects need to be discriminated
    - Whitecaps, Sea Ice, PIC